

ABSTRACT

Biased actuators having first and second magnetic members, a first electromagnetic coil, the first magnetic member being moveable relative to the second magnetic member between first and second positions, and being electromagnetically attracted to the first position by electrical excitation of the first electromagnetic coil, a first preloaded spring configured to apply a first spring force to the first magnetic member biasing the first magnetic member towards the second position only when the first magnetic member is in or between the first position and some fraction of its travel from the first position to the second position. Various embodiments are disclosed, including embodiments having a second spring acting as a return spring throughout the motion of the first magnetic member, and dual electromagnetic coil configurations. Exemplary embodiments are disclosed with respect to spool-type valves.